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ARTICLE

Effect of bariatric surgery on semen parameters and sex hormone concentrations: a prospective study

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Abstract Obesity has become a major health concern, with a prevalence rate approaching epidemic states. An inverse relationship between men's body weight and semen parameters has been observed, suggesting a favourable role for weight loss in improving fertility. This prospective study included 46 patients undergoing sleeve gastrectomy, who were investigated with semen analysis and serum hormone tests before and 12 months after surgery. Patients were divided into three groups according to their initial sperm concentration; median loss of body mass index was used as a cut-off to further classify patients according to extent of weight loss. Patients' preoperative seminal investigations revealed azoospermia in 13 (28.3%), oligospermia in 19 (41.3%) and normal sperm concentration in 14 (30.4%). Overall, only serum testosterone significantly increased after surgery ($P < 0.001$). Between study groups, the increase in sperm concentration was statistically significant in men with azoospermia and oligospermia (both $P < 0.05$), whereas serum testosterone was statistically significant in all groups ($P < 0.001$). Changes in semen and hormone tests were not affected by the extent of weight loss experienced by patients. Weight loss from bariatric surgery had a favourable effect on serum testosterone levels and semen parameters of patients with pre-existing azoospermia and oligospermia.

KEYWORDS: azoospermia, bariatric surgery, male infertility, obesity, oligospermia, testosterone

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Introduction

Obesity, categorized as a medical disease (AMA, 2013), has become a global health concern after reaching epidemic levels. Its prevalence has nearly doubled over the past 3 decades (Nguyen and El-Serag, 2010). According to the World Health Organization (WHO), 2014 marked more than 1.9 billion adults as overweight and more than 600 million as obese (WHO, 2015). The effect of obesity on humans is not just limited to general health, but also reproductive health. In a recent systemic review by Sermondade et al. (2013), an elevated risk of infertility was detected among couples when the male partner was overweight or obese. Among these patients, a higher incidence of semen abnormalities was observed (Sermondade et al., 2013). Reasons for this association are likely to be related to the effect of obesity on male reproductive hormones. Significant reductions in total testosterone, free testosterone and sex hormone-binding globulin, as well as elevation of oestradiol in obese men, are well documented (MacDonald et al., 2010).

Weight loss is generally believed to be of value in restoring fertility and normal hormonal profiles. Despite a widespread agreement on this fact, no well-designed studies have been conducted to prove it. A 4-month weight-loss programme was associated with an increase in testosterone, and decreases in the serum concentrations of insulin and leptin (Kaukua et al., 2003). Gastric bypass and banding operations are highly successful in treating morbid obesity. In spite of their ability to induce substantial weight loss, improve numerous obesity-related co-morbidities and increase life expectancy (Reis and Dias, 2012), fewer studies have investigated their beneficial effect on fertility and sexual function, and the results are conflicting. Two studies confirmed a favourable effect for bariatric surgery in correcting hormonal imbalance and improving the sexual quality of life (Bastounis et al., 1998; Reis and Dias, 2012). Contrary to this, however, small-case reports (di Frega et al., 2005; Sermondade et al., 2012) have highlighted a harmful effect of rapid weight loss on sperm function and fertility, suggesting it to be secondary to malabsorption of nutrients that inevitably occurs after such procedures.

To the best of our knowledge, this is the largest prospective study aiming to explore the long-term effect of bariatric surgery on semen parameters and hormonal profile.

Materials and methods

This prospective study was conducted at Hamad Medical Corporation, Doha, Qatar, a high-volume tertiary medical centre. Male patients who complained of primary or secondary infertility, and who presented to the institute's Male Infertility Unit, were invited to participate in this study. Patient selection involved taking a complete history and conducting a physical examination. Patients meeting the National Institute of Health (NIH) criteria indicating weight loss surgery were included (NIH, 1991). The exclusion criteria, on the other hand, were the use of current or previous fertility treatments and the presence of medical or genetic conditions with obvious detrimental fertility effects. Examples include patients with prior history of testicular trauma, malignancy or mal-descent, history of endocrinopathies and history of vasal surgery. All patients provided signed informed consent before joining, and the study was approved by the institute's Local Ethics Committee on 12 January 2014 (reference number MRC058).

A semen analysis and serum hormone profile was taken from all study participants before and 12 months after surgery. This time-period was selected to ensure sufficient weight reduction and recovery from the initial injurious effects of rapid weight loss on semen parameters. Semen analysis was carried out 3–5 days after sexual abstinence. Semen was collection in a clean container via masturbation. Samples were incubated at 37°C and allowed to liquefy for 30 min before analysis. The analysis was carried out according to WHO 2010 guidelines (Cooper et al., 2010). Blood samples for hormonal assay were collected from each patient individually between 7 and 9 am, and the analysis was conducted in the endocrine laboratory of our facility using the immunoassay chemiluminescence method, Architect i1000SR® (Abbott systems, Illinois, USA). The hormonal profile FSH (normal range 1–19 IU/L), LH (normal range 1–9 IU/L), prolactin (normal range 73–407 mIU/L), total testosterone (normal range 10.4–35 nmol/L) and oestradiol (normal range 73–275 pmol/L). All patients with initial sperm concentration less than 5 million sperm/ml were evaluated by karyotype analysis and Y chromosome microdeletion.

Laparoscopic sleeve gastrectomy was carried out in all patients by the same team of surgeons and according to the technique described by Gagner et al. (2008). Patients were then followed regularly by a nutritionist who tracked their compliance with the postoperative dietary plan.

Results of laboratory investigations, as well as changes in patients' body mass index before and 12 months after surgery, were compared. Patients were divided according to the initial sperm concentration into three groups. Azoospermia group (sperm concentration 0 million/ml), oligospermia group (sperm concentration $<$ 15 million/ml) and normal semen group (sperm concentration $\geq$ 15 million/ml). Patients were also subdivided according to the degree of change in body mass index (BMI) after surgery. The median BMI reduction was used as a reference point. Patients with reductions more than the overall median BMI decrease constituted group A, whereas those who had less than the overall median BMI decrease constituted group B. The total motile sperm concentration (TMC) (calculated by multiplying semen volume $\times$ concentration $\times$ total motility) was measured. The value was subclassified into less than 5 million, 5–20 million and over 20 million. Changes in TMC values were noted before and after bariatric surgery among the oligospermia group.

Statistical analysis was carried out using appropriate tests. Categorical variables were expressed as numbers (percentages), whereas numerical variables were presented as median (interquartile range [IQR]). Pearson's chi-squared test and Mann–Whitney U test were used for categorical variables and numerical variables, respectively. $P < 0.05$ was considered significant. All data were analysed using SPSS® version 20 (IBM, Armonk, NY, USA).

Results

Fifty patients met the inclusion and exclusion criteria and were invited to participate in this study. Four patients were lost

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